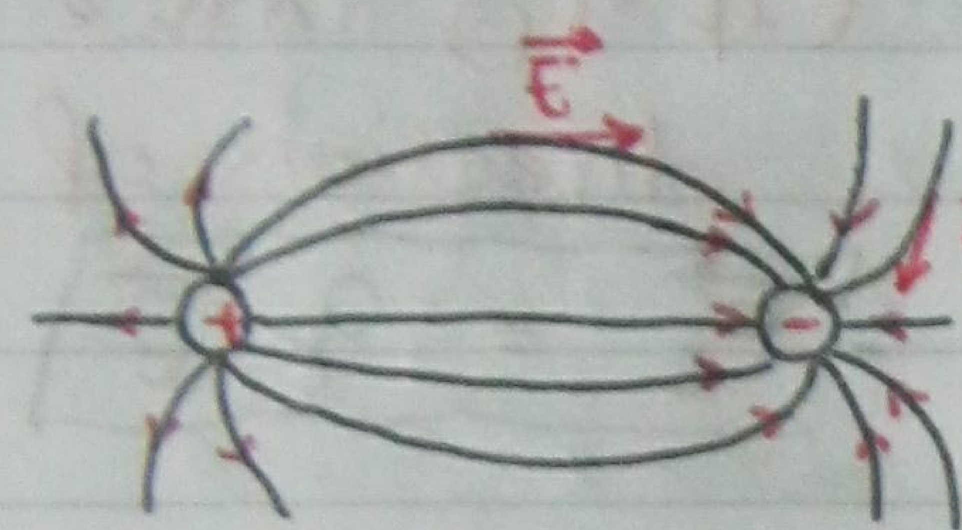
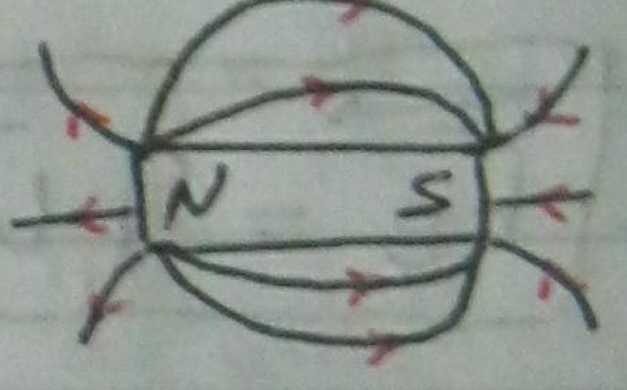
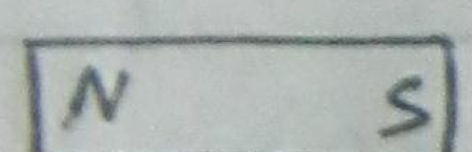
11/2/2012

→ Applications of magnetic field

1) Data storage /read/write.
2) Medical MRI (magnetic Resonance Imaging)
3) High speed train.
4) Motors.

Electric Field	Magnetic field
→ Form from static charges	→ Form from moving charges → Magnetic Materials.
	
- charges can be spearated - direction from (+ to -) and $\vec{E}$ is tangent	- Magnetic Poles can't be separated - direction from (N to S)

→ Magnet :



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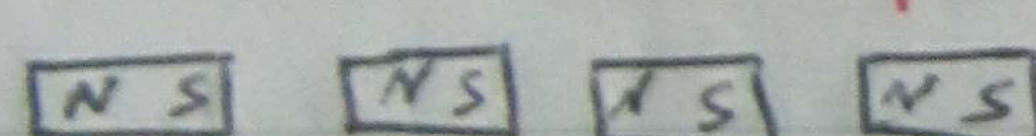

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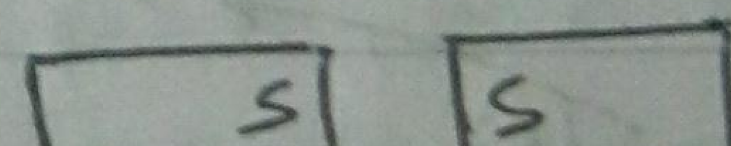
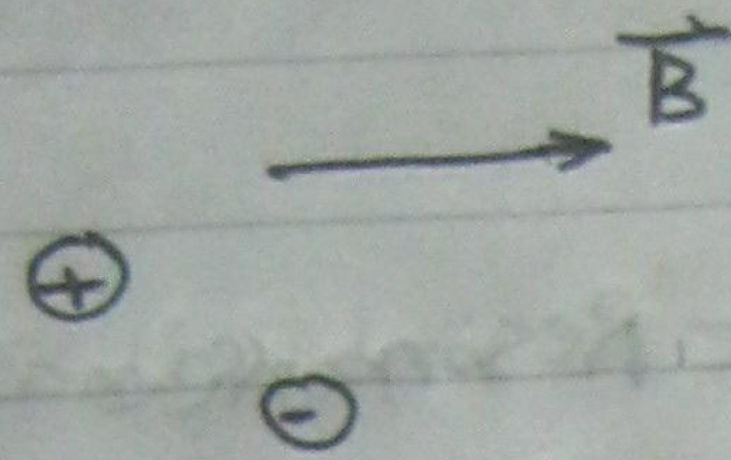
attraction



repulsion

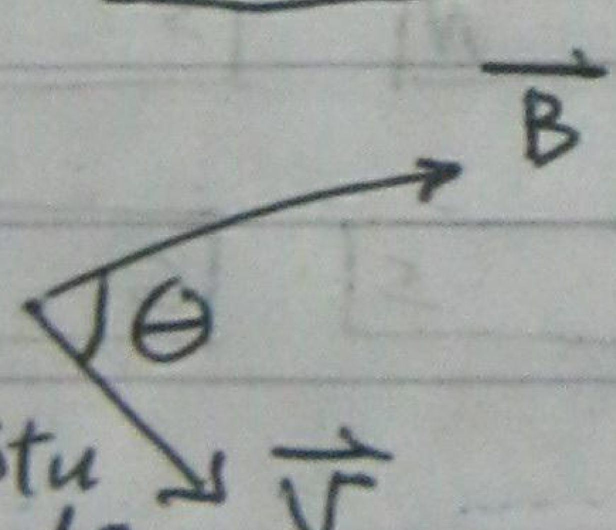
→ Magnetic field :	→ Electric Field
$\vec{B}$: magnetic field intensity	$\vec{E}$: electric field intensity.
unit : Tesla (T) Gauss (G) 1 Gauss = 10^{-4} Tesla	unit : V/m or N/c
$T \equiv \frac{N s}{C m}$ By $\left(B = \frac{F_B}{q v \sin\theta} \right)$	$\boxed{\frac{\vec{E}}{\vec{B}} \text{ ; Velocity}}$

Magnetic Force (F_B)



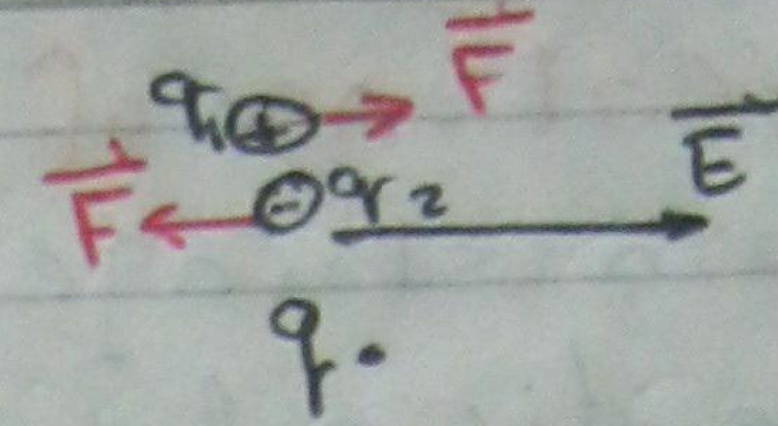
- Experimentally
- Force (F_B)
  $F_B \propto q$, $F_B \propto B$
  $F_B \propto v$
- $F_B \perp v$, $F_B \perp B$
- $\boxed{\vec{F_B} = q \vec{v} \times \vec{B}}$
  - v : velosity.
  - B : magnetic Field.

$\boxed{|\vec{F_B}| = q v B \sin\theta}$



$\sin\theta$ ↓ To have magnitude.

Electric Force (F_E)

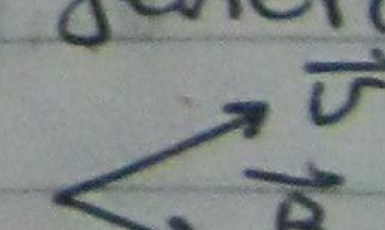


- a Field $\vec{E}$ with a charge q in it.
- There is a force affect the charge.
- The direction af force
  (If $q \oplus$ in the dire. of $\vec{E}$)
  (If $q \ominus$ in the opposite direction af $\vec{E}$)
- $\boxed{\vec{F_E} = q \vec{E}}$
- charges static or moving

Written By : Hady Tarek
Section : 45
AsuEng.com

F_B

- static charge
  - $v = 0$
  - then, $F_B = 0$
- moving charge
  - $\vec{v} \parallel \vec{B}$
    - then, $\theta = 0$ or 180
    - Hence, $F_B = 0$
  - $\vec{v} \perp \vec{B}$
    - then, $\theta = 90°$
    - Hence, $F_B = \underline{q v B}$
  - general



Hence, $\underline{F_B = q v B \sin\theta}$

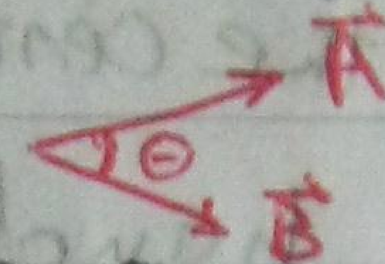
→ How to Find the direction of the magnetic force?

If $\vec{C} = \vec{A} \times \vec{B}$

(direction of C by right hand role : put your hand on $\vec{A}$ like and move your

① four finger from $\vec{A}$ to $\vec{B}$ by the smaller angle then the fifth finger is towards the direction of $\vec{C}$).

(when the direction of moving from left to wirte like



The direction is ~~inside~~ into the page) sign ⊙

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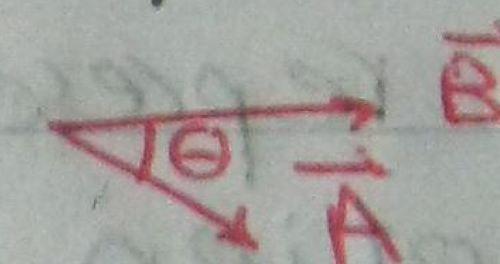
② and (when the direction of moving from right to left like



The direction is out of the page) sign ⊗

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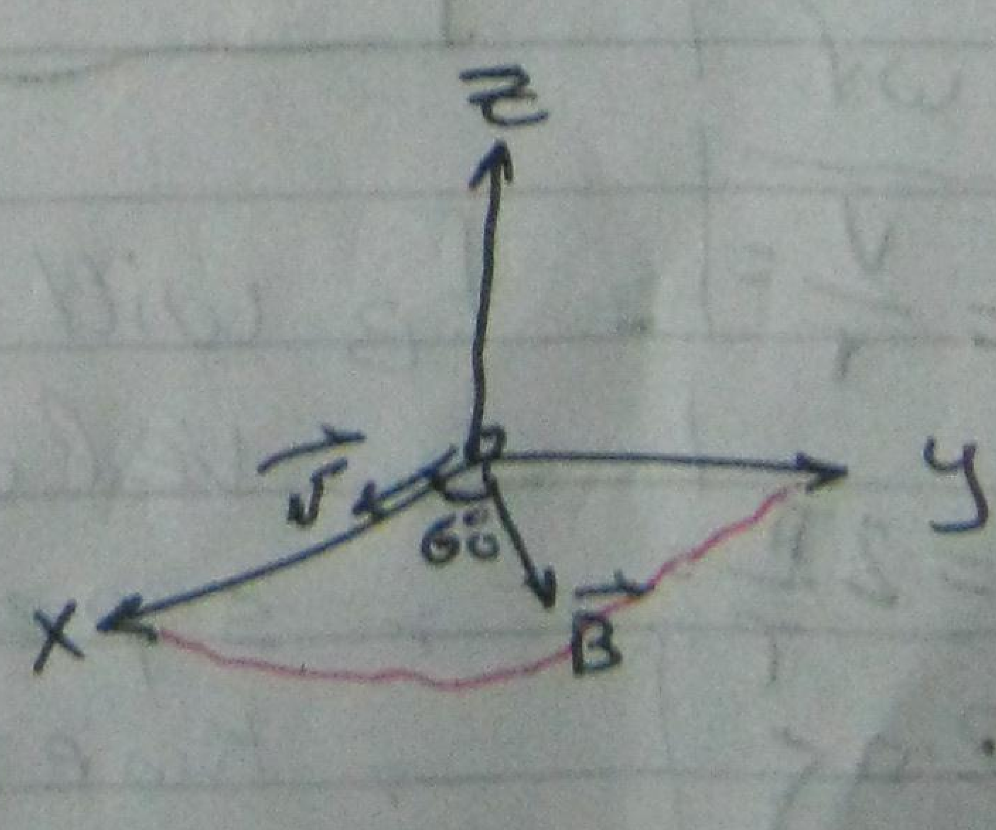
ex ① An electron in a T.V tube move foward the front of the tube with $\upsilon = 8 \times 10^6$ m/s along x axis. Taking B = 0.025 T directed at an angle of 60° to the x axis and long the xy planes. find the magnetic force acting on the electron.



$\vec{F_B} = q\vec{\upsilon} \times \vec{B}$

$|\vec{F_B}| = |q|\,\upsilon B \sin\theta$

$q = 1{,}6 \times 10^{-19}$ C, $\upsilon = 8 \times 10^6$ m/s

$B = 0.025$ T, $\theta = 60°$

$F_B = 2{,}8 \times 10^{-14}$ N.

(magnitude of magnetic force)

. To find the direction of $(\vec{F_B})$ in ex.

1) use any role to find the direction. So, it will be in Z direction.

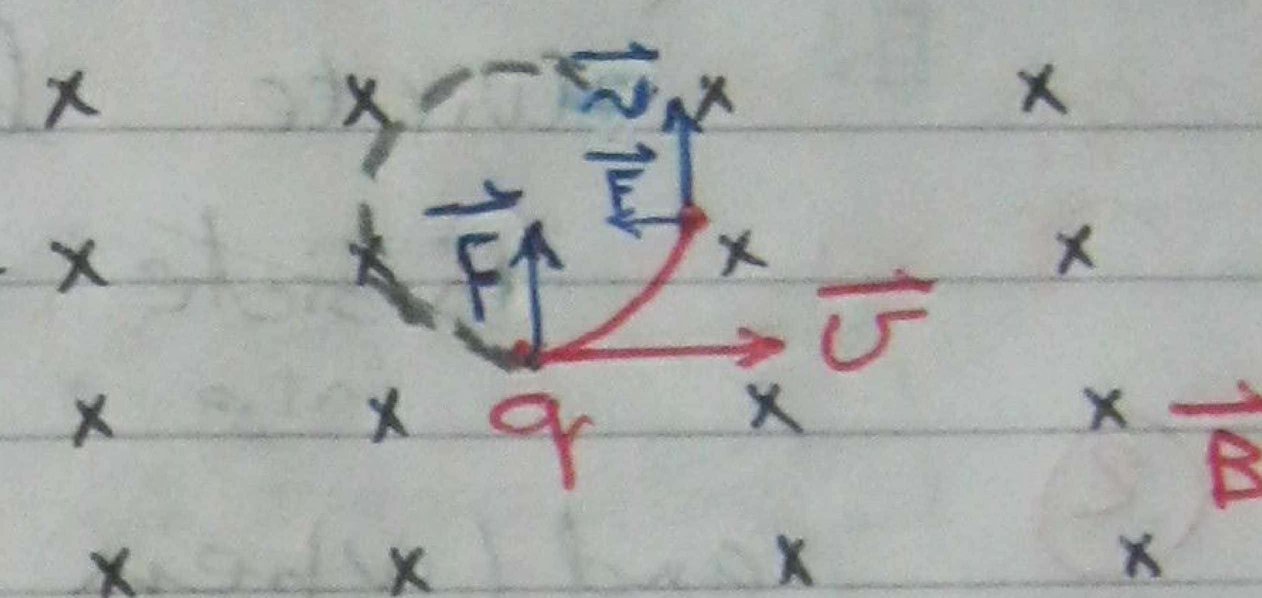
2) Taking the sign of charge into consideration as it is -ve so $(\vec{F_B})$ is directed along the (-Z) direction.

→ Moving of a charged particle in a uniform magnetic field :

(into the page)

$\vec{V} \perp \vec{B}$ (To the center)

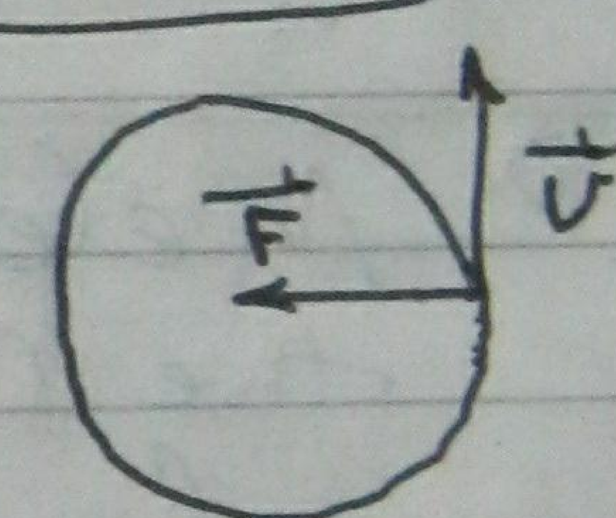
- By the right hand role
  $\vec{F}$ is directed upwards



- It represents circular motion.

q (+ve) charge

circular motion



- $\Sigma F = F_{cent.}$

$\because \Sigma f = F_B = qVB$

$\Rightarrow qVB = \frac{mV^2}{r}$

$\Sigma F = F_{cent} = m\frac{V^2}{r}$

$$\boxed{r = \frac{mV}{qB}}$$

Radius of the circular motion.

speed : magnit.
velocity : vector

Note:
$S = r\theta$
$V = \omega r$
$\frac{qB}{m} = \frac{V}{r} = \omega = \frac{2\pi}{T} = 2\pi f$

- F_B will affect ;
  → velocity ✓ $(\vec{V})$
  → speed X (V)
  → Kinetic energy X $(\frac{1}{2}mV^2)$
  → momentum ✓ $(m\vec{V})$

. F_B has an effection on velocity not speed!